

CLAIMS

1. A method of etching a chromium-based thin film, the method being for processing an object comprising the chromium-based thin film made of a material containing chromium, the thin film being etched using a resist pattern as a mask, the thin film being etched by the use of a chemical species produced by preparing a dry etching gas containing a halogen-containing gas and an oxygen-containing gas and supplying a plasma excitation power to the dry etching gas to thereby excite plasma, wherein:
 - the thin film is etched using, as the plasma excitation power, a power lower than a plasma excitation power at which plasma density jump occurs.
2. The method of etching a chromium-based thin film according to claim 1, wherein the halogen-containing gas is a chlorine-containing gas.
3. The method of etching a chromium-based thin film according to claim 1, wherein the dry etching gas further contains helium.
4. The method of etching a chromium-based thin film according to any one of claims 1 to 3, wherein the thin film is etched while supplying at least a part of the chemical species to the thin film in a direction perpendicular to the thin film, so that the thin film is etched while an organic substance is deposited on a side wall of the resist pattern being etched by an isotropic etching component.
5. The method of etching a chromium-based thin film according to claim 4, wherein at least a part of the chemical species is supplied to the thin film in the direction perpendicular to the thin film by applying a high-frequency power to the object.
6. The method of etching a chromium-based thin film according to claim 4 or 5, wherein at least a part of the chemical species is supplied to the thin film in the direction perpendicular to the thin film so that an etching selectivity between the resist pattern and the thin film (thin film etch rate/resist pattern etch

rate) is smaller than 1.5.

7. The method of etching a chromium-based thin film according to any one of claims 1 to 6, wherein a resist layer of the resist pattern has a coverage of 70% or more with respect to the thin film.

5 8. The method of etching a chromium-based thin film according to any one of claims 1 to 6, wherein the thin film is etched in presence of an organic substance other than the resist pattern if a resist layer of the resist pattern has a coverage smaller than 70% with respect to the thin film.

10 9. A method of etching a chromium-based thin film, the method being for processing an object comprising the chromium-based thin film made of a material containing chromium, the thin film being etched using a resist pattern as a mask, the thin film being etched by the use of a chemical species produced by preparing a dry etching gas containing a halogen-containing gas and an oxygen-containing gas and supplying a plasma excitation power to the dry
15 etching gas to thereby excite plasma, wherein:

the thin film is etched in presence of an organic substance other than the resist pattern while supplying at least a part of the chemical species to the thin film in a direction perpendicular to the thin film, so that the thin film is etched while an organic product is deposited on a side wall of the resist layer being
20 etched by an isotropic etching component.

10. The method of etching a chromium-based thin film according to claim 9, wherein the halogen-containing gas is a chlorine-containing gas.

11. The method of etching a chromium-based thin film according to claim 9 or 10, wherein the presence of the organic substance other than the
25 resist pattern is established by adding an organic gas to the dry etching gas as the organic substance other than the resist pattern.

12. The method of etching a chromium-based thin film according to claim 11, wherein the amount of the organic gas is 30 vol% or less of the dry

etching gas.

13. The method of etching a chromium-based thin film according to claim 11 or 12, wherein the organic gas is ethanol.

14. The method of etching a chromium-based thin film according to claim 9 or 10, wherein an organic polymer material is disposed in an etching chamber as the organic substance other than the resist pattern.

15. The method of etching a chromium-based thin film according to any one of claims 9 through 14, wherein the thin film is etched using, as the plasma excitation power, a power lower than a plasma excitation power at which plasma density jump occurs.

16. The method of etching a chromium-based thin film according to claim 15, wherein the dry etching gas further contains helium.

17. The method of etching a chromium-based thin film according to any one of claims 1 to 16, wherein the object is a photomask blank comprising a transparent substrate and a light-shielding film made of a material containing chromium and formed on the transparent substrate.

18. A method of manufacturing a photomask from a photomask blank comprising a transparent substrate and a light-shielding film made of a material containing chromium and formed on the transparent substrate, the method comprising a step of etching the light-shielding film by the use of a resist layer in a resist pattern as a mask, wherein:

the step of etching the light-shielding film is carried out using the method of etching a chromium-based thin film according to claim 17.

19. The method of manufacturing a photomask according to claim 18, wherein, by etching the light-shielding film, a pattern including an optical proximity correction (OPC) pattern is formed.

20. The method of manufacturing a photomask according to claim 18 or 19, wherein, by etching the light-shielding film, a pattern including a pattern of

which a design size is $4\mu\text{m}$ or more and $2.0\mu\text{m}$ or less and of which a CD linearity error is 15nm or less is formed.